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relatively large amounts of heat from the electronic device via passive heat transfer to air surrounding the three-dimensional structure by maximizing surface area and providing apertures or passageways that allow air to be driven into or through the device, for example by a fan, to remove even more heat from the electronic device. These enhanced levels of heat removal, as described above, can result in significant performance gains for the electronic device and can allow for the use of components or operating levels that heretofore may not have been achievable with existing three-dimensional structures.

The structures described herein can enhance characteristics of other aspects of the electronic devices with which they are associated. For example, when used as a housing or other structural component of an electronic device, a three-dimensional structure as described herein can provide a high level of strength and stiffness to weight ratio to the device. Traditional structures often achieve enhanced stiffness or strength by thickening or enlarging certain portions of the structure, often resulting in an increase in the weight and size of the electronic device, which may not be desirable to a user. The three-dimensional structures described herein can include, for example, a matrix of passageways that serves to greatly enhance the stiffness of the three-dimensional structure, without significantly increasing the size or weight of the structure. Thus, a relatively lightweight, yet extremely strong and stiff electronic device can be produced.

The light weight and stiffness of the three-dimensional structure can also provide a user with a pleasing experience when handling the device. While light weight, the three-dimensional structure is sufficiently rigid and tough to allow the electronic device to be used over a long period of time while maintaining dimensional stability. Additionally, the present structure allows for custom designs to be 3D printed or manufactured that optimize a number of factors including weight, rigidity, heat transfer considerations, and manufacturability. In some cases, a three-dimensional structure can include a relatively intricate repeating pattern that, in addition to enhancing heat removal capabilities and providing stiffness, provides a visually interesting or aesthetically pleasing effect to the user. Such a three-dimensional structure, for example when used as a housing, can also include a variety of colors on one or more regions of the housing to enhance the visual appearance and provide a pleasing aesthetic experience to the user.

Further, in some embodiments, the three-dimensional structures described herein can act as shielding for the electronic device, while still allowing for air flow there through. For example, in some cases, a three-dimensional structure can act as an electromagnetic interference (EMI) and/or electromagnetic compatibility (EMC) noise shield for one or more components housed therein. In some embodiments, such as where the three-dimensional structure includes a metal and/or conductive material, the structure can provide EMI and/or EMC shielding for one or more electronic components of the device, such as integrated circuits. Thus, in some cases, additional shielding material and/or measures may not be needed to achieve a desired level of EMI and/or EMC shielding because of the three-dimensional structure. This beneficial shielding effect can thus reduce the cost and weight of a device, while providing other enhanced characteristics, as discussed herein.

Any pattern or arrangement of cavities extending into the body from a surface is expressly contemplated, although in some embodiments the cavities may be arranged in a substantially uniform and regular pattern. For example, in some embodiments where the cavities extending into the body

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from a surface have the shape of at least a portion of a sphere or hemisphere, the cavities may be arranged in a close-packed pattern, such as a hexagonal close-packed pattern. In some embodiments, the cavities extending into the body from the first surface and the cavities extending into the body from the second surface can be arranged or disposed in a pattern. The pattern of the cavities extending into the body from the first surface can be the same as the pattern of cavities extending into the body from the second surface, although in some embodiments, the two patterns of cavities may not be the same. As described above with respect to the cavities extending into the body from the first and second surfaces intersecting to form the three-dimensional pattern or matrix, the pattern of cavities extending into the body from the first surface can intersect or interfere with the pattern of cavities extending into the body from the second surface to produce or define the three-dimensional pattern or matrix in the body.

In some embodiments, a structure can include or be formed from any machinable or formable material. For example, in some embodiments a three-dimensional structure can include or be formed from a material such as a metal, a ceramic, an amorphous material such as glass or an amorphous metal, a polymer, or combinations thereof. In some embodiments, a three-dimensional structure is a metal. In some embodiments, the metal can be an elemental metal or a metal alloy. In some embodiments, the three-dimensional structure can include metals such as aluminum or steel. For example, the three-dimensional structure can be aluminum or an aluminum alloy. In some embodiments, the three-dimensional structure can include a 6000 series aluminum alloy, for example a 6060, 6061, or 6063 aluminum alloy. In some embodiments, for example where the three-dimensional structure includes a metal and/or conductive material, the structure can act as an EMC/EMI noise shield.

The structures described herein, for example as used in electronic devices, can be formed by a variety of methods and processes. In some embodiments, a three-dimensional structure can be formed by etching, machining, casting, stamping, forging, forming, injection molding, or the like. Further, multiple methods of forming structures can be employed to form a single structure. For example, one or more cavities extending into the body from a first surface of the body of a three-dimensional structure can be formed by a stamping, molding, or forming process, while one or more cavities extending into the body from a second surface of the body of the three-dimensional structure can be formed by a machining or etching process.

In some embodiments, one or more methods of forming structures can be employed multiple times to form the three-dimensional structure. For example, one or more cavities can be formed by machining the first surface, while additional cavities can be formed by machining the second surface. In some embodiments, for example, where the first and second surfaces are opposing surfaces, the body may be flipped or rotated after the first surface has been machined in order to machine the second surface. In some embodiments, the body may again be rotated to machine the first and second surfaces additional times.

In some embodiments, three-dimensional structures can be formed by, for example, stamping or forming the body to create one or more cavities extending into the body from the first surface. The second surface can then be, for example, machined or etched to form one or more cavities extending into the body from the second surface, thereby created the three-dimensional pattern of apertures. In some embodiments, a material can be added to the first and/or second